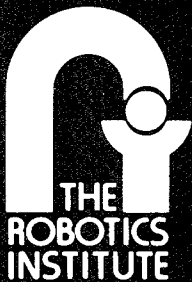


**Deciding Where Technology Ends
and
the Law Begins**

Robert Thibadeau
August, 1993
CMU-RI-TR-95-07

19950425 047



Carnegie Mellon University

The Robotics Institute

Technical Report

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

Deciding Where Technology Ends and the Law Begins

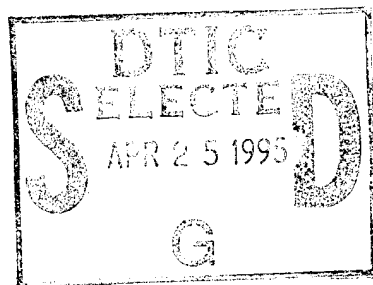
Robert Thibadeau

August, 1993

CMU-RI-TR-95-07

The Robotics Institute
Carnegie Mellon University
Pittsburgh, Pennsylvania 15213

Copyright (c) 1995 Robert Thibadeau



Accession For	
NTIS CRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification _____	
By _____	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

ABSTRACT

This is a non-technical paper intended to provoke thought. It examines an internationally proposed digital television standard as the basis for laws that protect ownership in the information age.

Deciding Where Technology Ends and the Law Begins

**Robert Thibadeau, Ph.D.
School of Computer Science
Carnegie Mellon University**

A few years ago, I began a venture called Television Computer, Inc., with Dick Leghorn of Massachusetts, the father of Cable Laboratories. In his many teachings, we considered the problem of personal rights, obligations, and property security on what has now become known as the information superhighway. We are both technologists, but we recognized no amount of technology can provide ultimate security, in property, rights, or obligations, since there is always the case of the "privileged insider" who can abuse the system. Furthermore, as recent CIA spying cases have shown, such "privileged insiders" are not figments of the technologist's imagination. Then Dick said something to me, "The interesting problem is drawing the line where technology ends and the law begins." This is, indeed, an interesting problem. Technologists should write about this problem. We are not the legal scholars, but we understand technology potential. Something a lawyer may think is hard and confusing, we may know to be reasonable and straightforward. This article describes a partnership between law and technology that invigorates and incentivizes free commerce, minimizes government, and pays its own way.

The information superhighway of today is the Internet. But this highway is just barely civilized and is surely the wild west of the end of the twentieth century. Congress would also spread this wild west into telephone and television. This is a land that the Progress and Freedom Foundation has called "cyberspace." Being from the old school of computer science, I think of it as a land of symbols, like the symbols that are words on this page, the dollar bills in your pocket, or the stamps on an envelope. It is an intrinsic part of present day reality. It impinges with ever increasing substance on all aspects of life, liberty, and the pursuit of happiness.

Even though a world of symbols may seem alien, mankind, through dealings in money, government, and religion, has been finding ways to draw the legal line in the land of symbols for thousands of years. One should first assume there is nothing new here, in cyberspace, except the variety of symbols and the speed with which they are manipulated.

Where, in law, should we look for guidance? Take a look at the 'wild west' of capitalism. At a recent Progress and Freedom Foundation conference, it was observed that foreigners commonly suspect that capitalism is controlled by a master conspiracy. No, the speaker countered; it is driven in a chaos of opportunity, by incentive, but not by a ruling conspiracy. I would argue this opinion is mistaken. Capitalism flourishes when there is a heavy hand of the law: the old fashioned, steadfast, protection of property. Capitalism is indeed constructed by a conspiracy: a conspiracy among those few people who write and judge property laws. In the world of cyberspace, we should carefully construct our notions of "property," and we should carefully construct our notions of "the form of the property protection laws." I submit that this is stuff for the most human, common sense and ages old, kind of consideration. It is not the stuff for confusion.

The rule that creates order is property law. Theft, the violation of individual ownership, is a very basic and old legal notion. But don't confuse theft in the world of symbols with a violation of copyright law! Copyright law, and other, more esoteric forms of law, including all "intellectual property," and "regulation," evolve from basic property law. The wild west of cyberspace lacks consensus on basic property, so it is no wonder that people, including this author, are confused

about "intellectual property," and people find "regulation" inappropriate. Sit back through the last millennium, and recognize how complicated but simple, and pervasive but specific, this thing of property is. I suppose the land of cyberspace is lawless precisely because most people are prematurely worried about "copyright," "regulation," or "technical means for insuring ownership." Such things assume a consensus exists about what can be owned in cyberspace, and how it can be owned. But where is this consensus?

Discussion that provides a recipe for consensus should precede a lot of what is popularly discussed today. In the lawless Internet today, about the only activity one can prudently justify is giving stuff away free. This is an ancient act of a peasantry in a lawless land -- the abrogation of rights in order to survive. With property laws for protection, value is created by the limitation to access. In the creation of value, the cost of property law pays for itself.

Without a clear notion of property, and the law designed to protect it, we can only rely on technical means. You will have to pay the technology lords, the IBM, EDS, Microsoft, RSA, or Netscape, Inc., to protect your rights. But we know, *a priori*, that technical means for protection, unaccompanied by law, are at best "renegade," and "fiefdom" laws, and, at worst, invitations for hackers and theft. The mafias of cyberspace are, at this moment, being created by well-intentioned people as well as ill-intentioned ones. No IBM, EDS, Microsoft, RSA, or Netscape wants consciously to be a mafia or a petty lord, but absolute power corrupts. Human rights need the protection of law.

On this note, let us turn to the oldest symbolic property, money, and then to the next oldest, stamps. Money and stamps are not "copyrighted," they are owned!

Money has been a common human artifact for thousands of years. The word is "stuff" like "water," but it is really composed of a large collection of symbols. A coin or bill is a symbol for wealth. Even when a coin is gold or a bill is backed by gold, the amount of gold is still a symbol for wealth. It is abstract, like any good symbol, because it can substitute for many different things in physical reality. Money could exist in cyberspace. Cyberspace is a region of countless symbols, in countless variety, all moving about, interacting with one another, and cheaply accessed with a personal computer and modem. But, again we are premature. Before we discuss money in cyberspace, we need to discuss property: the symbols of cyberspace as things that money buys. Consider money as *a prototype* for how law is historically written for things as non-substantive as symbols.

The government guarantees, with law, two attributes of money, your right to possess it and a universal quantitative measure of it. One dollar can be yours. The government, through *theft laws*, secures this right. Furthermore, law *authorizes the denominations* of money: one dollar is one dollar, while five is the sum of five ones. However, this authorization does not define value: the law allows you to exchange a five for six ones.

As a service, the government *protects the value* of the money. Nowadays, the government skips the gold standard (an older symbology), and controls, by law, the printing and minting of money. There is only one authorized source of money. The law that protects production is *counterfeiting law*. It is a felony to print your own money. A popular misconception is that they make it hard to counterfeit bills, but, as a member of the Technical Association for Graphics Arts, I will tell you that most people in the printing industry know it is not *that* hard. It is simply illegal.

There are laws of theft and counterfeiting, but no governmental laws that say you have to trade a five for five ones. We presume, here, laws made by men and natural laws that men do not have to state. But notice, we have natural law, here, applied by men to a symbol made entirely by men. Hurray! People, for centuries, have already figured out a system of laws coupled to a system of common sense that governs the abstract interactions of abstract symbols!

Now, consider another place where the law is curiously absent, or largely absent. The government does not, by law, guarantee a right to trade the property of a dollar with the property of a good or service. The trade laws that do exist are fairness laws that say, mainly, that if you already trade goods for money, you cannot unreasonably withhold further trade. The government does not enforce specific trade value by law. While there are arguable exceptions, in the case of governmental interactions with other sovereign states, or banks working with the central bank, the value of money, inside the country's economy, is largely left free. People recognize that freedom to set trade value is good, and that price regulation is not good. In fact, price regulation tends to correlate with distortions of property ownership. Witness communism.

The system of money is supported by more than a majority rule. There is overwhelming consensus that exists among the people. If, for example, 1% of the people disagreed with the prohibition on printing money, over a million people in America would be counterfeiting. This many people conspiring to counterfeit would surely send the system into a tailspin. People don't do it because there is an overwhelming consensus with the law.

Property law on symbols tend to be effective and easy to maintain when there is law reinforced by consensus. The question of where to draw the line is a human question, and humans must find comfort in the answers. If the answers give the appearance of unduly constraining freedom or, alternatively, violating an ethical reserve, the lines drawn will not be obeyed. The laws governing money are wonderful examples of good laws that invigorate commerce without creating a huge bureaucracy. The bureaucracy can be small because the consensus is great, and because the tasks of enforcement and judgement are simple to understand.

Symbols in cyberspace can be similarly protected by law. Here is the recipe that expands the way to think about where to draw a line when technology ends and the law begins: *Protect the ownership rights and obligations of the symbol that stands for the content, and let the symbol that stands for the content declare the property rights expected for the content.* The symbol that needs legal protection afforded a dollar bill has the form of a label or stamp.

Most of the above discussion of money applies as well to postage stamps. Furthermore, the "cancel" stamp the post office stamps on top of the postage stamp is a dependent label protected from misuse by law. It is illegal to open a letter that is stamped, cancelled, and not labeled for your receipt. I would argue that digital stamps are the right place to start in thinking about laws in cyberspace.

A label or stamp in cyberspace cannot look "pretty or distinctive," since the physical symbol itself is a transient collection of electrons or photons. However, as with money, we should be able to guarantee that the symbol is unique. That guarantee of uniqueness can be global. If I can "print" a cyberspace stamp that only I have the authority to print, and I can print it knowing that that stamp is globally unique, then I can print something that, as a matter of the necessities of legal theory, looks a lot like money or postal stamps.

Such a globally unique labelling scheme has just recently been proposed for use in cyberspace by the Society of Motion Picture and Television Engineers (SMPTE) "Header/Descriptor working group," of which I am a member. This group was formed under the authority of the International Telecommunications Union of the United Nations (the ITU) and the U.S. Advanced Television Systems Committee (ATSC). The ATSC is the successor to the NTSC (N for "National"), and it was the NTSC that, around 1950, brought you the television that is in your home today. For clarity, let us signify this globally unique label as a Label (capital "L"). A Label can be thought of as a stamp if, someday, it gets legally protected like a stamp. Otherwise, it is just a Label.

The SMPTE working group is concerned with property in cyberspace, because our members know that motion pictures and television programs are being brought to cyberspace. But, nearly everybody else we can imagine should be similarly concerned. Bankers, manufacturers, teachers, lawyers, one and all, should be concerned with Labels. Cyberspace, like the wild west, is a place where anybody should be able to seek their fortune.

In order to better understand the Label, recognize that, like letters in the mail, words on a page, or dollars in your pocket, symbols in cyberspace come in bundles. People deal in bundles of symbols. Just call any such bundle, "a message." The Label standard has to do with Labels we might care to put on messages.

Labels can provide the "postage" stamp on a message, the "cancel" stamp on the postage, the address on the message, and the "return" address. But Labels are not restricted to just these types. Think about a message with possibly many different stamps. Perhaps, the stamps that we should be inventing are not exactly like 'postage,' 'cancellation,' 'sender,' and 'receiver.' Perhaps some are. Perhaps some Labels should be protected by law that protects rights and enforces obligations, and some should not.

Our SMPTE Label proposal talks about the form of Labels -- how they must be constructed to guarantee their global uniqueness, and how an unencumbered authority may yet produce new Labels without asking any organization for permission.

Labels achieve this seeming impossibility by appending successive authorities that have authorized successive names. People are familiar with the principle of naming their children. This is the same principle but it guarantees globally unique names. Like the name "John Smith," a Label has its family name and name within the family, but unlike "John Smith", the Label explicitly states all its ancestors back to the global root, and it is, mainly because of this, guaranteed to be globally unique.

Among Labels, there would be no other "John Smith" in the world, but the Smith's would not have to consult any other authority or gain any permission in order to name a son "John." For the Label proposal, the authorities are arranged in strict descendancy from the single global root point, an entity established by the United Nations, the International Telecommunications Union or ITU. Here is a partial listing of the progenitors and origins of all global Labels:

ITU (International Telecommunications Union of the United Nations)

- |- CCITT [0] (Telephone Consultative Committee)
 - |- recommendation [0] (CCITT Standards)
 - |- question [1]
 - |- administration [2]
 - |- network-operator [3]
- |- ISO/IEC [1] (International Standards Organization,
International Electrotechnical Committee)
 - |- standard[0] (ISO standards)
 - |-registration authority [1] (ISO authorities)
 - |-member body [2] (identified by telephone country code)
 - |-Russia [7] (Russia can generate unique Labels without asking permission)
 - |-United States [31] (same for the U.S.)
 - |-China [8] (same for China)
 - |-organization [3]
 - |-SMPTE [52] (Society of Motion Picture and Television Engineers)
 - |-ANSI (American National Standards Institute)

By the way these Labels work, an authority can create new Labels by appending more Label

information to the Label he now has. Thus, SMPTE has the unique name "ITU organization SMPTE." The actual Label uses code numbers: ITU[1] organization[1] SMPTE[52] or 1.1.52. SMPTE may create, in a fully sovereign fashion, a Label for something it wishes to name. Since this is an engineering group, let us suppose it wants a Label for one of its digital communications standards, "260M". the Label is then "1.1.52.260M". The important points are that this Label is guaranteed to be globally unique and the sovereign authority over this Label is SMPTE. If I ever encounter the Label 1.1.52.260M, I can contact SMPTE and ask whether the person using this Label had the right to use it. This is no different from my encountering a dollar bill and asking the Secret Service if it is a counterfeit. However, it might be that SMPTE explains that anybody can use this Label as long as the message conforms to the SMPTE standard message form for "260M." The misuse of other kinds of Labels could be a felony: for example, an illegally obtained or illegally used ITU[1].memberbody[2].United States[31].cyberpostage_stamp_\$1.00[24] Label.

A country has a unique name, "ITU[1].memberbody[2].United States[31]." The United States is granted the authority to "mint" its Labels, and its immediate descendents, but not Russia's or any other Labels. People and organizations should be able to mint their own Labels. Good judgement says there should perhaps be a universal human right to a sovereign Label. Perhaps this right should be protected in a bill of rights.

The beauty of this system is that it is decentralized while guaranteeing that any Label is globally unique or as unique as a traceable authority has chosen to make it. The ITU, or entities under it, can establish registration authorities that generate Labels that may be owned by others. For example, the ITU could establish a[n] message-ownership registration authority, call it ITU-ownership, and allow any person or entity the right to have a Label in it that is composed of ITU-ownership and the person's Label in his country. The ITU or United States, on its own, could establish a \$1.00 copyright protection Label that provides the owner with a misdemeanor legal protection on his copyright and a \$1000 copyright protection Label that protects the owner with a felonious legal protection. Illegally using such a Label could be felonious counterfeiting. Money could be generated with Labels although these would certainly need added technical security. Such security is afforded through a Label type we have called "composite."

Now, suppose we pass a law that says that Label ownership of your personal (or corporate) Label is ordinary property ownership. You can sell the message that your ownership stamp is on. Furthermore you can sell your ownership in that stamp. Furthermore, you cannot claim to own something you do not, in fact, own, and you cannot use anybody's ownership stamp without their authority to do so. Now, suppose I encounter a message that says it is mine, but I know it is not mine. I report the false attribution as counterfeiting. Furthermore, I may encounter somebody else's stamp on a message I believe that I own. I can now attempt to show the theft.

Another interesting problem is the problem of designing stamps that can provide a trace of counterfeiting or theft with the aid of technical means. So, for example, certain telecommunications networks may have tracing capability, and a stamp may designate that a message is not to leave that network. If it ever does, the possessor of the message is in illegal possession.

One must be careful with stamps. For example, a Label may state that the contents of a packet are in an encoded form. A Law could require that the use of that Label be correct. On the other hand, we may say that a contents encoding Label will have no adverse consequences, and no enforcement is needed. "Natural" law will take care of keeping such Labels right.

We might put a country of origin stamp on a message. It would be possible to pass a national law that says that messages encountered at our superhighway borders must have a country of origin Label. If they do not, they will be turned away at the border and not allowed to enter. At the

border, a packet may require a tax stamp...ah, Label. Furthermore, it is illegal to fake these Labels. The tax Label authority retains the right to disburse the Labels. Again, technical means are available that can help the authority do this, but the legal remedy is the final remedy for abuse.

A copyright is another kind of stamp that (as is well recognized) is different from ownership. Indeed a copyright may be seen as a collection of permissions administered by different authorities. I find the whole concept of a right to copy ill-advised in cyberspace. The machines that keep cyberspace running smoothly are constantly copying. It would be impossible, even if they were well-advised, to keep track of all the 'illegal' copying that goes on.

Rather, suppose it were illegal for certain Labels to be removed from a message once placed on it, and that these Labels had owners who designated who is permitted to read the message. This is like the law that says that it is illegal to read a letter or otherwise tamper with the U.S. Mail. We completely bypass "copyright" as a right to copy and change this to a right to read, a "readright." So, if a message owner requires payment when his message is to be read, anyone reading the message must show he has obtained a stamp from the owner that provides the permission. Again, while technical means, such as encryption, may be used to verify a stamp's authenticity, it is the authority that can ultimately state whether the permission has been given or the rules under which the permission is to be given.

I believe that this implies a place for copyright authorities that are somewhat unlike the existing ones. A copyright authority under a Label could specify the rules under which copyrights listed under its authority are maintained. The recent action by international treaty that removes the need for a copyright notice is, in this view, ill-advised. If an author intends for his material to be restricted, he should indicate the rules for reading his work. For example, a telephone company, or all telephone companies, could provide a copyright Label, or perhaps a family of copyright Labels that stipulate different restrictions. These Labels insure that the copyright owners' intentions regarding copying are communicated in a uniform and globally unique way to any receivers in the telephone system. The question, then, is whether the government should recognize such copyright Labels with legal sanctions. Lawmakers may want to think twice about enforcing industry specific uses. But there could be a severe sanction against the misuse of the Label itself, and a lesser sanction against violating the industry meaning intended for the Label -- what the Label labels.

At the beginning of this article, I promised a method for thinking about what laws congress should pass for the information superhighway. Whether we wind up adopting the SMPTE Labels, a fun method is to sit down and list every Label you can think of. Take a while to do this, and don't rush. Then make up little tables for thought experiments. Here is one of mine:

Legal Remedy for Misuse	Simple Label (e.g., Postage Stamp)	Dependent Label (e.g., Cancellation Stamp)
None	Data Type Clocking Characteristics Priorities	Subchannel, Cochannal (e.g., stereo) Other Clocking Characteristics Priority Specifications Version Number
Civil Suit	Time Sent Any Readright	Financial Transaction Authority Cost Advisory
Misdemeanor	Source Label Destination Label \$1 Readright	Source Characteristics Destination Characteristics Reading Rules
Felony	Owner Label Legal Tender Label with Amount Country of Origin \$1000 Readright	Owner Characteristics

I suspect a serious list contains at least 10,000 possible Labels. Out of this candidate list, only a handful of Labels should be selected for legal sanctioning. Furthermore, it may be possible to have Labels that fund their own enforcement. The Label provides for a natural means of this. For example, a single registration authority is created for "Felonious Copyright Infringement." Registration with this group costs a person or company money (in order to keep the law vigilant only on goods with established high value) and the registration also opens the registrant to a counter liability if he is registering material he does not own the copyright for. So, for example, this would tend to attract movies and books. Another authority could be created for misdemeanor infringement registration, and everybody else gets civil action guaranteed.

One word on such technical means for achieving security as data encryption: the Label is designed to reinforce this security and not to replace it. For example, in the proposed Label standard, a Label can contain a "digital signature" that goes as far as technology can go in insuring security. The subject of another article is how the Label represents a reasonable approach to bridging the responsibility of technology and law.

I have been on the Internet and its precursors for many years (I am rht@cs.cmu.edu since 1980). But when I encountered its new hypercard-like user interface, the World Wide Web (now seen as Mosaic or Netscape), I saw something many people were seeing, and I wrote the following poem. The last line concerns a symbol over 6,000 years old, the earliest known Chinese symbol of the dragon, that later evolved into the symbol for wisdom, fertility, and the Emperor's rule:

World Wide Web

-Robert Thibadeau

November 30, 1993

***I never thought I would see the day
When books looked superfluous.***

***I saw, the day before yesterday,
the world.***

***I leapt about, from Japan, to Here, to
Australia
to Finland,
to Italy.***

Like it was nothing.

***And I got deep
Deep
Into people
What they were thinking and doing
What they wanted and thought
I might like.***

***This is what a book was supposed to be.
But this was much better.
I made up the plot, and I discovered the real story.***

***All right there. Right then. And,
like the world,
It would never repeat again.***

***Oh.
I really would like to have books with their tree paper
go the way of the dinosaur.
This is nearly it.***

It is a place to really learn.

Will Internet become the dragon?

You know, the house dragon. The oldest dragon. From China.

*You know, the
Dragon of Peace holding the Pearl of Everlasting Life.*

With the Internet we are close to something good. In the interest of civilization and capitalism ... peace and everlasting life ... consider how to own something in that world, and keep it simple. So consider a vision, I own a message because my stamp is on it, and I let anybody read it, because I stamped it that way. I can sell you the message by making a serializing stamp for it, and selling you a right to use that serial numbered stamp in place of mine. That stamp does not allow you to sell more than just that one stamp. But, for that "copy," you own it. ...I keep thinking about all that software *I bought that is owned by somebody else*, and keep thinking something is fundamentally wrong, here, in the lawless world of cyberspace.

Robert Thibadeau, Ph.D., is Director of Imaging Systems Laboratory in the School of Computer Science at Carnegie Mellon University. This laboratory has been building imaging systems since 1980 -- as diverse as headlamp/taillamp computer aided design for GM, railroad car recognition for CSX (ref. Wall Street Journal, 1990), and high definition television for ARPA. He is currently involved in telecommunications standards through the internationally accredited Society of Motion Picture and Television Engineers (SMPTE) Header/Descriptor Committee for Advanced Television and also through the industry trade group known as the Interactive Multimedia Association (IMA).

Appendix A.

Text of Proposed SMPTE Label Standard

DRAFT -- Note. This is NOT an approved standard. It is being provided only as a conceptual reference for the text of this technical report. For the text of the approved standard, if any, contact SMPTE:

Committee on Television Production Technology
Working Group on Headers and Descriptors
Society of Motion Picture and Television Engineers
595 West Hartsdale Avenue
White Plains, New York 10607-1824
Telephone (914) 761 1100
Fax: (914) 761 3115

PROPOSED

SMPTE STANDARD

Labels for Unique Identification of Digital Data

1 Scope

This standard defines globally unique Labels to be used in identifying message contents within a general purpose data stream. The Labels are intended to function across all types of digital communications protocols and message structures, allowing the intermixture in a communications channel of message contents of any sort.

For SMPTE documents, the standard defines the mechanism for distinguishing the messages created through use of the related standard or recommended practice in the generation of the data stream.

This standard is also intended to serve as a model for other organizations that wish to label message contents in a manner that will be universally unambiguous, globally unique, and traceable to the authorizing organization.

2 Normative References

International Standard ISO 8824 (ITU X.208), Abstract Syntax Notation 1

International Standard ISO 8825 (ITU X.209), ASN.1 Basic Encoding Rules

International Standard ITU X.509, The Directory Authentication Framework, Section 8.7 (Distinguished Encoding Rules)

3 Label Name Space

The Label name space follows the conventions for object identifiers in ISO standard 8824

(ITU Recommendation X.208).

Within this Label standard, the type and format of messages exchanged in a general purpose digital data stream SHALL be identified using the ISO/ITU network object and data type registration system as defined by ISO standard 8824 (ITU Recommendation X.208). A label is composed of a path specification (also called an ISO/ITU Network Object) and an identifier (also called a Data Type specified by the Network Object).

ISO/ITU identifiers are organized in a hierarchy that is registered and administered internationally by ISO, ITU, and their constituent organizations. The root (prefixes) of the identifier hierarchy is:

```
Identifier
|
|
|-- ITU[0]
|   |-- recommendation[0]      : ITU committees
|   |-- question[1]           : ITU Study Groups
|   |-- administration[2]     : country PTTs (country code)
|   |-- network operator[3]   : X.121 organizations
|
|-- ISO[1]
|   |-- standard[0]           : ISO standards
|   |-- registration authority[1] : ISO registration authorities:
|   |   |-- ...               : delegated to registration
|   |   |                       authorities (e.g., IEEE)
|   |
|   |-- member body[2]        : member bodies (country code)
|   |-- identified organization[3] : organizations
|   |   |-- ...               : delegated to international orgs.
|   |   |-- SMPTE[52]         : delegated to SMPTE
|   |   |-- ...               :
|
'-- joint ISO ITU[2]          : delegated to ANSI
```

4 Notation

The following notation is used to specify names in the ISO/ITU name space hierarchy. A name is a sequence of unsigned integers that designate a location in the name space starting at the root and selecting what branch to take as each level of the hierarchy is descended. Positions in the hierarchy are indicated by using numeric values, associated alphanumeric symbols, or both. The following examples are all valid identifiers of the ITU T.4 (Group 3 Fax) standard:

```
{itu(0) recommendation(0) t(20) 4}
{0 0 20 4}
{itu recommendation t 4}
```

The initial symbol "itu" (value 0) indicates the name is an International Telecommunications Union (ITU) administered name. The second symbol "recommendation" (value 0) indicates the name identifies an ITU recommendation. ITU recommendations are administered by committees A through Z, thus 20 indicates that committee T (20 is the location of T in the alphabet) wrote the recommendation. The value 4 identifies the committee document that specifies Group 3 Fax. For example using this name in a message header would identify a message as containing Group 3 Fax data.

All ISO standards are registered as {iso(1) standard(0)}. International registration authorities, such as IEEE, are registered under {iso(1) registration-authority(1)}. Sovereign bodies are registered under {iso(1) member-body(2) country-code}. ISO delegates registration authority to international organizations (e.g., SMPTE) and companies under {iso(1) organization(3)} so that individual organizations can autonomously administer a portion of the name space.

5 Label Definition

A Label is defined in the Abstract Syntax Notation (ASN.1, ITU X.208). A Label is a structure that shall be composed of either (a) one primitive OBJECT IDENTIFIER or (b) one constructed EXTERNAL object which has a single OBJECT IDENTIFIER and a single OCTET STRING. The OBJECT IDENTIFIER in either form of Label refers to the ITU/ISO name space. The OCTET STRING is administered and defined by the organization identified by the OBJECT IDENTIFIER.

Thus, in the language of ASN.1, a SMPTE Label SHALL be defined as either a simple OBJECT IDENTIFIER or a constructed composite object identifier. Formally this choice is expressed:

```
Label ::= IMPLICIT CHOICE
{
    single-identifier      OBJECT IDENTIFIER,
    composite-identifier   EXTERNAL
}
```

where "::=" signifies an ASN.1 type definition, the brackets enclose a definition's value. The terms in lower case are ASN.1 values, the terms beginning with an uppercase letter (e.g., "Label") are ASN.1 types, and the terms entirely in uppercase are ASN.1 macros.

And, from the specification for the ASN.1 EXTERNAL macro, as it is taken from page 96 section 34.4 of ITU X.208, is, in this specification, the composite identifier SHALL take exactly this form:

```
EXTERNAL ::= [UNIVERSAL 8] IMPLICIT SEQUENCE
{
```

```

        direct-reference      OBJECT IDENTIFIER,
        encoding              CHOICE
    {
        octet-aligned          [1] IMPLICIT OCTET STRING,
    }
}

```

6 Encoding Rules

Labels SHALL be encoded (as shown below) according to the Basic Encoding Rules as specified by ISO 8825 (ITU X.209) and restricted according to the Distinguished Encoding Rules specified by ITU X.509 section 8.7 with the additions that:

(1) The rules for encoding Labels SHALL result in four-octet alignment of octet aligned bits for each and every label. To accomplish this alignment an additional encoding rule is that octets having a value of zero SHALL fill all remaining octet positions in a partially-filled four octet sequence. The zero-value octet fill, therefore, SHALL be right-aligned and trailing-octet-aligned.

Briefly,

```

single-identifier ::= OBJECT IDENTIFIER.tag + OBJECT IDENTIFIER.length + OBJECT IDENTIFIER
+ (zero-octet padding)

```

where "::=" is the rewrite rule, "+" indicates a strict sequence, and the parentheses indicate an option taken to meet the requirement of four-octet alignment.

(2) For constructed label, there SHALL be one specification that is assigned by the network object that SHALL provide padding for four-octet alignment of the data type according to a rule stated by the network object authority.

Briefly,

```

composite-identifier ::= EXTERNAL.tag + length + OBJECT IDENTIFIER.tag + OBJECT
IDENTIFIER.length + OBJECT IDENTIFIER + (zero-octet padding) + CHOICE[1].tag + length +
OCTET STRING + (zero-octet padding)

```

7 SMPTE Rules and Obligations

As shown in the tree presented in section 3, the SMPTE is registered as ISO international organization number 52. Thus the SMPTE organization is uniquely identified by the following internationally recognized name:

```
{iso(1) organization(3) smpte(52)}
```

The SMPTE has authority to assign and administer all names in the

ISO/ITU name space that begin with this prefix. These names SHALL be known as "SMPTE Names". Message formats specified by conforming SMPTE standards and recommended practices SHALL be assigned SMPTE Names. Policies and procedures for assigning SMPTE Names (i.e., how the SMPTE administers its portion of the ISO/ITU name space) are to be specified.

The SMPTE SHOULD register the names of all existing SMPTE standards to conform with the Label definition and encoding. The SMPTE SHOULD decide the final form for and register the names of all future SMPTE standards and recommendations to conform with the Label definition and encoding.

The SMPTE SHALL maintain a registration facility wherein any organization may register its Labels and wherein properly registered Labels will be publicly available.

Informative Annex

Discussion of Restrictions on Label Encodings

The ASN.1 Universal Tags that may be employed in Labels are:

Universal Tag	ASN.1 Type
6	OBJECT IDENTIFIER
8	EXTERNAL

If the EXTERNAL tag is used to designate a composite-identifier, then the ASN.1 Meta Type, CHOICE with a selection of 1 is required to designate the required payload. This encoding is always 81 in hexadecimal being composed of the "8" part that designates a context-specific CHOICE and the "1" part that designates a choice of "1" according to the full definition given by the specification for the ASN.1 EXTERNAL type, as it is shown on page 96section 34.4 of ITU X.208, which is,

```
EXTERNAL ::= [UNIVERSAL 8] IMPLICIT SEQUENCE
{
    direct-reference      OBJECT IDENTIFIER OPTIONAL,
    indirect-reference    INTEGER OPTIONAL,
    data-value-descriptor ObjectDescriptor OPTIONAL,
    encoding              CHOICE
    {
        single-ASN1-type [0] ANY,
        octet-aligned     [1] IMPLICIT OCTET STRING,
        arbitrary         [2] IMPLICIT BIT STRING
    }
}
```

Examples of Label Encodings

The first example is the simple case of an authority using the primitive OBJECT IDENTIFIER in order to declare a standard encoding for the data associated with a single-identifier label:

```
. ASN.1 OBJECT IDENTIFIER tag is 6
| . Length of object identifier is 4 bytes
| | . ITU(0). recommendation(0).
| | | . committee(8)
| | | | . Px64 (261)
| | | | | . zero fill to complete second four octets
| | | | |
06 04 00 08 82 05 00 00
      |           | -> Four Octet Boundaries
```

The second and third examples are fictitious examples of how a organization could choose between two alternative labelling methods. It is assumed that the registration authority, in this case SMPTE, would mandate that one or the other representation be universally employed.

The second example is the SMPTE Standard 240M defined as a primitive case of an authority using the single-identifier for the standard designation "260M." Note because this example is also "naturally" aligned to four octets, there is no zero padding.

```
. OBJECT IDENTIFIER tag
| . object identifier length is 2 bytes
| | . ITU(1).org(3)
| | | . SMPTE(52)
| | | | . ASCII "2"
| | | | | . ASCII "6"
| | | | | . ASCII "0"
| | | | | . ASCII "M"
| | | | |
06 06 2B 34 32 36 30 4D
      |           | -> Four Octet Boundaries
```

The third example is the SMPTE Standard 240M defined as a constructed case of an authority using the composite-identifier EXTERNAL tag with an OBJECT IDENTIFIER and implicit OCTET STRING for the standard designation "240M." Note because this example is "naturally" aligned to four octets, there is no zero padding.

```
. EXTERNAL tag with constructed bit set
| . Length of constructed external is 10 bytes
| | . OBJECT IDENTIFIER tag
| | | . object identifier length is 2 bytes
| | | | . ITU(1).org(3)
| | | | | . SMPTE(52)
| | | | | | . CHOICE[1] is implicit OCTET STRING
| | | | | | | . Length of Octet String is 4 octets
| | | | | | | | . ASCII "2"
| | | | | | | | | . ASCII "6"
| | | | | | | | | . ASCII "0"
| | | | | | | | | | . ASCII "M"
| | | | | | | | | | |
28 0A 06 02 2B 34 81 04 32 36 30 4D
      |           |           |           |
      |           |           |           | -> Four Octet Boundaries
```

Because the SMPTE standard is designated with ASCII characters, the above two examples are interchangeable in ASN.1 except for the requirement that only one of the two interchangeable forms be authorized by the authority. SMPTE would, presumably, authorize only the shorter, single identifier, form.

The fourth and fifth examples are fictional examples using the proposed IEEE RAC number. In this case, there is motivation for a composite identifier form. The fourth is as a primitive OBJECT IDENTIFIER:

```
. OBJECT IDENTIFIER tag
| . object identifier length is at least 10 bytes
| | . ITU(1).registration-authority(1)
| | | . IEEE([xx])
| | | | . at least 8 octet identifier number
06 [xx] 29 [xx] [8? octet universal identifier]
      |
```

But, suppose that IEEE RAC is concerned that their 8 octet universal identifier, under the Basic Encoding Rules for the OBJECT IDENTIFIER type, could result in more than 8 octets for expression. This is because the most significant bit of each octet in an OBJECT IDENTIFIER indicates a continuation bit. The 8 octet universal identifier would, in fact, require as many as 16 bytes depending on the number of continuations. If the IEEE regards this recoding as unacceptable, they may chose to employ the OCTET STRING method that insures bit to bit correspondence. The fifth example uses the composite identifier to achieve this end,

```
. EXTERNAL tag with constructed bit set
| . Length of constructed external is 14 bytes
```

```

| | . OBJECT IDENTIFIER tag
| | | . object identifier length is 2 bytes
| | | | . ITU(1).registration-authority(1)
| | | | | . IEEE ({xx})
| | | | | | . implicit OCTET STRING tag
| | | | | | | . Length of Octet String is 8 octets
| | | | | | | | .8 octet identifier number
| | | | | | | | |
28 0E 06 04 29 xx 81 08 [8 octet universal identifier]
| | | | |

```

Discussion of other Labels

While a SMPTE Label may designate a standard format for the associated data in a data stream, Labels need not be restricted to this purpose. The SMPTE Label is designed to be compatible with a variety of stream formats including those that are fully ASN.1 compliant and those that are not. In particular, because the SMPTE Label is always four octet aligned, it is compliant as a Unipack Label (footnote 1). Other uses of Labels may be as descriptors for copyrights, message source, message sub-channels, and clocking standards (footnote 2).

-
1. Note. See Gary Demos and David James; "Apple's Unipack Universal Header Proposal", SMPTE Conference Preprints, October 1993 SMPTE Conference, and G. Demos, D. James, D. Singer, et. al., "A Universal Packet Header Standard (UniPack)", SMPTE Conference Preprints, October 1994 SMPTE Conference.
 2. SMPTE Header/Descriptor Task Force: Final Report, SMPTE Journal, June 1992.

SMPTE Label Registration

A Label may be registered with SMPTE through the following form:

Title: _____

Registration Authority: _____

Short Abstract (Scope of Standard):

Label Type: single-identifier composite-identifier

Label (in Hexadecimal with zero padding):

First Four Octets ____/____/____/____
Second Four Octets ____/____/____/____
Third Four Octets ____/____/____/____
Fourth Four Octets ____/____/____/____
Fifth Four Octets ____/____/____/____
Sixth Four Octets ____/____/____/____
Seventh Four Octets ____/____/____/____
Eighth Four Octets ____/____/____/____

Contact

Header/Descriptor Working Group
Society of Motion Picture and Television Engineers
595 West Hartsdale Avenue
White Plains, New York 10607-1824

Appendix B.

A summary version of the article.

Deciding Where Technology Ends and the Law Begins

by Dr. Robert Thibadeau

Technologists realize there is no ultimate technical solution to information security, just as there is no ultimate technical solution to prevent muggings. The law must step in, at some point, and draw the line where technology ends and the law begins. This article spells out a way planners think about and construct such law for cyberspace.

Cyberspace is surely the wild west of the twentieth century, and it is spreading from Internet to telephone and television. This land is a land of symbols, like the symbols that are words on this page, the dollar bills in your pocket or the stamps on an envelope. But it is a land of countless symbols, in countless variety, all moving about, interacting with one another, and cheaply accessed with a personal computer and modem.

Even though a world of symbols may seem alien, mankind, through dealings in money, government, and religion, has been finding ways to draw the legal line in the land of symbols for thousands of years. Let's assume there is nothing new in cyberspace except the variety of symbols and the speed of their manipulation.

Where, in law, should we look for guidance? Take a look at the "wild west" of capitalism. Capitalism flourishes when there is a heavy hand of the law: the old fashioned, steadfast, protection of property. Theft, the violation of individual ownership, is a very basic and old legal notion.

But don't confuse theft in the world of symbols with a violation of copyright law! I would argue people are prematurely worried about *copyright*, *regulation* or *technical means for insuring ownership*. Such things assume a consensus exists about who owns what in cyberspace, and how it can be owned. But where is this consensus?

In the lawless Internet today, the one activity one can commercially justify is giving stuff away free. This is a peasant act in a lawless land -- the abrogation of rights in order to survive. With property law for protection, value is created by the limitation to access. In the creation of value, the cost of property law pays for itself.

I believe we can learn from the oldest forms of symbolic property -- money and stamps. A coin or bill is a symbol for wealth, and a stamp declares rights and obligations. One dollar, one stamp, can be yours. The government, through theft laws, secures this right. As further service, the government protects the value of the money through counterfeit laws. There is only one authority that can print money and stamps.

But, the government does not, by law, guarantee a specific right to trade the property of a dollar with another property. While there are arguable exceptions, people recognize that the unrestricted freedom to set trade value is good, and that price regulation is not good. Think about communism. Price regulation tends to correlate with distortions of property ownership.

Property law on symbols is effective when the law has consensus. The question of where to draw the line is a human question, and humans must find comfort in the answers. If the answer gives

the appearance of unduly constraining freedom or, alternatively, violating an ethical reserve, the line drawn will not be obeyed. The laws governing money and stamps are wonderful examples of laws that invigorate and incentivize free commerce, minimize government, and pay their own way.

Stamps in Cyberspace

Symbols in cyberspace can be similarly protected. Here is the recipe to think about deciding where technology ends and the law begins: *Legally protect the ownership rights and obligations of a symbol, and let the symbol that stands for content declare the property rights expected for the content.* Cyberspace symbols that need legal protection against theft and counterfeiting have the ancient form of stamps.

There can be many types of stamps. The *cancel* stamp the post office stamps on top of the postage stamp is a dependent label protected from misuse by law. It is illegal to open a letter that is stamped, cancelled, and labeled for somebody else's receipt. There is nothing "technical" here, stamps have to do with labels we might care to put on our messages.

A label or stamp in cyberspace cannot *look distinctive*, since the physical symbol is transient. However, as with dollars, the symbols must be globally unique. If I can *print* a cyberspace stamp that only I have the authority to print, then I can print something that, as a matter of the necessities of legal theory, looks a lot like money or postal stamps.

Such a globally unique labelling scheme has just recently been proposed for use in cyberspace by the "Header/Descriptor" working group of the Society of Motion Picture and Television Engineers, of which I am a member. We call our stamp a Label (capital "L"). Labels can provide the *address* on the message, and the *return* address on the message, the *postage* stamp on a message, and the *cancel* stamp on the postage. But Labels are not restricted to just these types. Think about messages with possibly many different stamps. Think about stamps two hundred years ago -- when stamps regulated commerce. Dream about stamps in the cyberspace of tomorrow.

Labels are globally unique, but any authority can produce new Labels without asking permission. Labels achieve this seeming impossibility by the principle of successive authority. Parents name their children. Among Labels, there would be no other *John Smith* in the world, but the Smiths would not have to consult any other authority in order to name a son *John*. Like the name *John Smith*, a Label has its family name and name within the family, but unlike *John Smith*, our Label explicitly states all its authorities back to a global root, and, because of this, it is guaranteed to be globally unique.

An authority can create new and unique Labels by appending more Label information to the Label he now has. While people, organizations, and governments can all mint their own Labels, the law should not protect all Labels equally. The fun is figuring out what Labels the law should protect, and how.

Copyright Protection in Cyberspace

Now, suppose we pass a law that says you can sell the message that your ownership stamp is on. This is one stamp for "you" and one stamp that claims this ownership. Furthermore, you cannot claim to own something you do not, in fact, own, and you cannot use anybody's personal stamp without their authority to do so. Now, suppose I encounter a message that says it is mine, but I know it is not mine. I report the false attribution as counterfeiting. Furthermore, I may encounter somebody else's stamp on a message I believe that I own. I can now attempt to show the theft.

A copyright may ultimately be seen as a collection of permissions administered by different authorities. But I find the whole concept of a right to copy ill-advised in cyberspace. The machines that keep cyberspace running smoothly are constantly copying. It would be impossible, even if it were well-advised, to keep track of all the 'illegal' copying that goes on.

Rather, suppose it were illegal for certain Labels to be removed from a message once placed on it, and that these Labels required permissions to read the message. This is like the law that says that it is illegal to read a letter or otherwise tamper with the U.S. Mail. We completely bypass *copyright* as a right to copy and change this to a right to read, a *readright*. So, if a message owner requires payment when his message is to be read, anyone reading the message must show he has obtained a stamp from the owner that provides the permission.

So, while technical means, such as encryption, may be used to verify a stamp's authenticity, or make it hard to illegally read the message, it is the stamp's owner that can ultimately state the permission. And, more importantly, it is the law that enforces such permission.

I believe that this implies copyright authorities that are somewhat unlike the existing ones. The recent action by international treaty that removes the need for a copyright notice is, in this view, ill-advised. If an author intends for his material to be restricted, he should indicate the rules for reading his work. Our group provides the means by which the U.S. government could authorize globally unique U.S. Government Readright Labels just like it prints U.S. Postage Stamps. Sanctions could exist against the fraudulent use of the Labels and against violating the Labels' asserted rights and obligations.

With the Internet we are close to something good. In the interest of civilizing the wild west of cyberspace, consider how to own something in that world, and keep it simple. So consider a vision, I own a message because my stamp is on it, and I let anybody read it, because I stamped it that way. I can sell you the message by making a serializing stamp for it, and now you own that instance of the message. That stamp does not allow you to sell more than just that one stamp. But, for that *copy*, you own it. ... I keep thinking about all that software I bought that is owned by somebody else, and keep thinking something is fundamentally wrong, here, in the lawlessness of cyberspace.

Robert Thibadeau, Ph.D., is Director of Imaging Systems Laboratory in the School of Computer Science at Carnegie Mellon University (Internet address: rht@cs.cmu.edu). The text has been abstracted from a more detailed paper by the same title, "Technical Report CMU-RI-TR-95-07, Robotics Institute, Carnegie Mellon University, Pittsburgh, PA 15213."